Broadband Radio Research and Propagation Measurements

Outputs

- Study of relative propagation impairments between 2.4 GHz ISM band and 5.8 GHz communications band.
- Study of MIMO antenna systems and information theory relating to MIMO systems.

An ongoing program of radiowave propagation research and measurements is supported using the ITS Mobile Measurements Facility and the Digital Sampling Channel Probe (DSCP). By using these facilities, researchers have the ability to determine propagation conditions and impairments which affect new digital communication systems and answer questions regarding the viability of proposed radio services. In the recent past these facilities were used to investigate propagation for personal communications services (PCS) at 1.85 GHz and local multipoint distribution services (LMDS) near 30 GHz. The measurement van is capable of fixed or mobile operation and the DSCP can be configured over a wide range of bandwidths and frequencies.

Recently the system was configured at four frequencies to study the relative propagation impairments between the 2.4 GHz ISM band and the recently allocated 5.8 GHz communications band. Mobile data was collected in an urban environment and the relative impairments were quantified. This data is intended to help system designers of next generation systems in the 5.8 GHz band determine the relative power requirements and link budgets needed versus systems in PCS and cellular bands. It will help promote commercial high frequency spectrum use and frequency extension. Figure 1 shows the routes surveyed in downtown Denver. Figure 2 shows the average path loss slopes over the measured frequency range. For more details of this work see references [1] and [2].

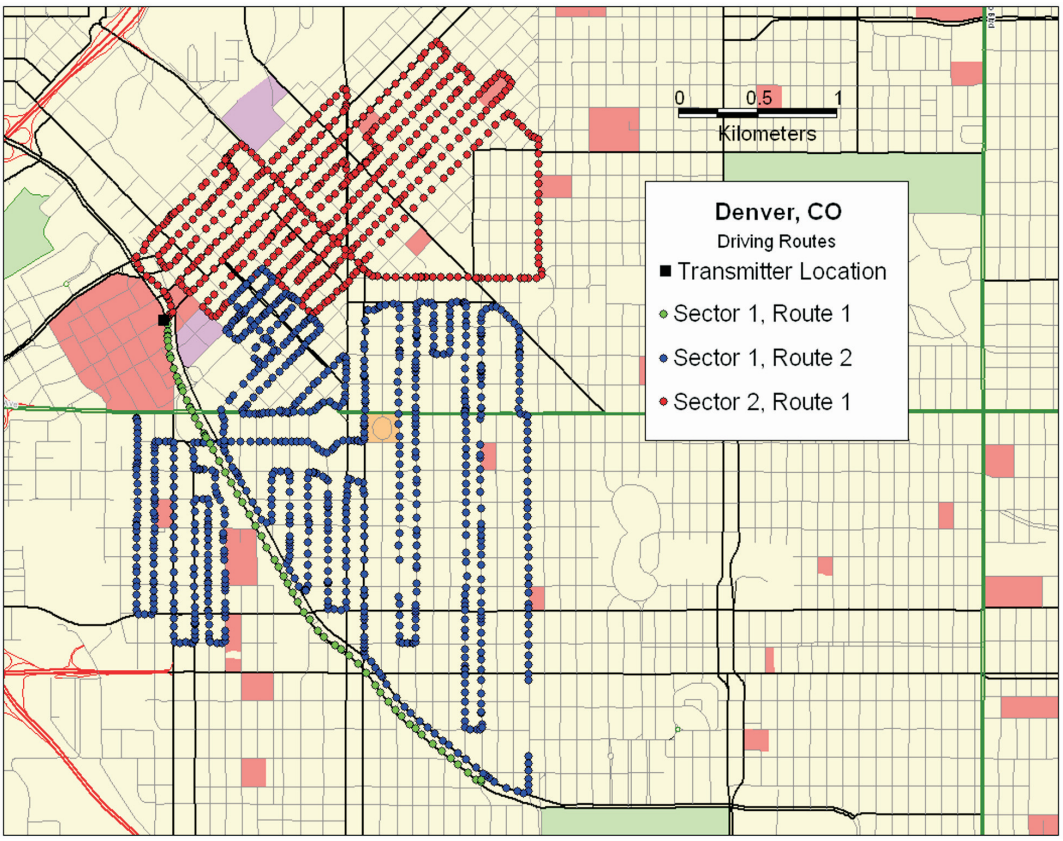

Figure 1. Drive route map for radiowave propagation survey in downtown Denver, CO.

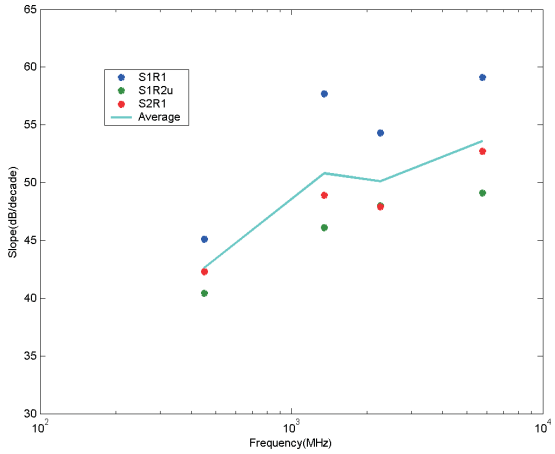

Figure 2. Lb slope versus frequency for three urban drive routes in Denver, CO.

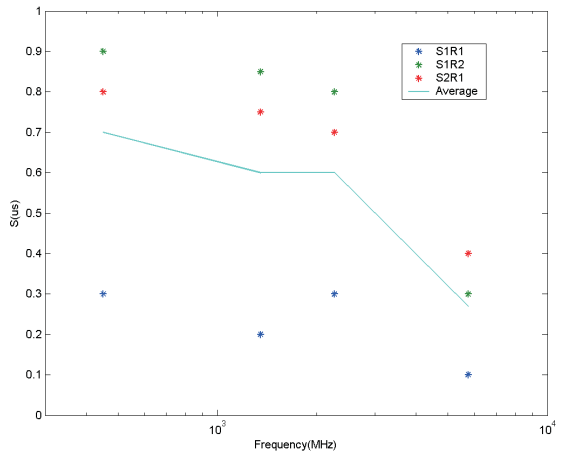

Figure 3. Average results for delay spread exceeded 50% of the time (S 50%) for 3 cells versus transmission frequency.

In addition to the path loss data, the relative delay spread versus frequency was also measured. In Figures 3 and 4 we see that delay spread decreased versus transmission frequency. More detailed analysis of these effects can be found in references [1] and [2].

In the coming year the Broadband Radio project will continue its work in the area of multiple input multiple output (MIMO) antenna systems. The purpose of this work is to advance spectrum efficiency using new high capacity radio technology. The project plans to work cooperatively with NIST to characterize a reverberation chamber for use in testing MIMO systems. ITS will also continue its study of information theory relating to MIMO systems.

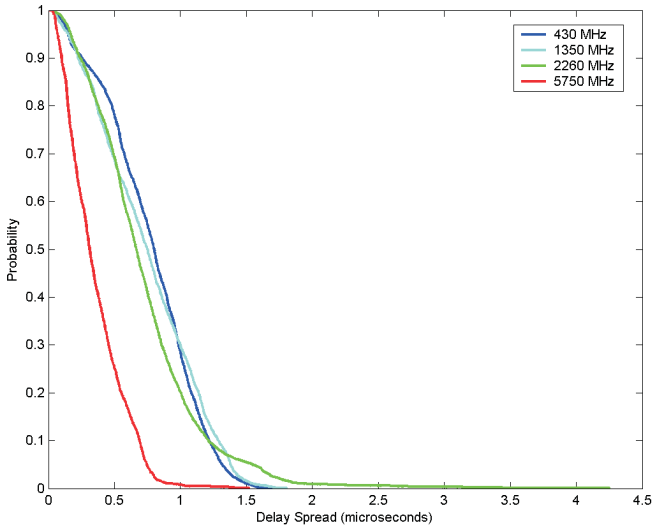

Figure 4. The cumulative distribution function of delay spread versus transmission frequency for cell 2 route 1.

Recent Publications

[1] P. Papazian and M. Cotton, "Relative propagation impairments between 430 MHz and 5750 MHz for mobile communication systems in urban environments," NTIA Report TR-04-407, Dec. 2003.

[2] P. Papazian, "Basic transmission loss and delay spread measurements for frequencies between 430 MHz and 5750 MHz," to be published in *IEEE Transactions on Antennas and Propagation*, Feb. 2005.

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